

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Human activities & cultural practices	Land Use	Monitor water use adjacent to or upstream from park boundaries	H5	Water Use(s) Within & Surrounding Parks	Which resources are most at risk due to conflicting water uses (withdrawals, diversions, inputs)?	Stream gages, well monitoring/logs	Volume, rate	3.0	
	Park Use & Activities	Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas	H7	Litter/debris	What are levels of litter within parks? Where is littering/ dumping of trash taking place? What are areas of marine debris deposition?	surveys of activity & locations	quantity present / removed	3.1	
Physical / Chemical Conditions	Monitor water quality core parameters		P20	Ground Water Quality Core parameters	Is variation within normal range? What are temporal trends?	water sampling from dedicated monitoring wells in addition to supply wells	temperature, pH, salinity (sp. cond.), Dissolved Oxygen,	2.8	
			P21	Marine Water Quality Core parameters	Is variation within normal range? What are temporal trends?	in-situ measurements and collection of samples at established sites including controls	temperature, pH, salinity (sp. cond.), Dissolved Oxygen, PAR	3.3	
			P22	Surface Water Quality Core parameters	Is variation within normal range? What are temporal trends?	in-situ measurements and collection of samples at established sites including controls	temperature, pH, salinity (sp. cond.), Dissolved Oxygen, PAR	3.6	
	Monitor supplemental water quality parameters		P23	Ground Water Quality Supplemental parameters	Is variation within normal range? What are temporal trends?	water sampling from dedicated monitoring wells in addition to supply wells	nutrients, total suspended solids/turbidity, chlorophyll A , alkalinity, anions, cations, redox, total organic carbon,	2.6	
			P24	Marine Water Quality Supplemental parameters	Is variation within normal range? What are temporal trends?	in-situ measurements and collection of samples at established sites including controls	nutrients, total suspended solids/turbidity, chlorophyll A , alkalinity, anions, cations, redox, total organic carbon,	2.9	
			P25	Surface Water Quality Supplemental parameters	Is variation within normal range? What are temporal trends?	in-situ measurements and collection of samples at established sites including controls	nutrients, total suspended solids/turbidity, chlorophyll A , alkalinity, anions, cations, redox, total organic carbon,	3.5	
	Monitor microbiological water quality parameters		P26	Ground Water Quality - Microbiology	Is variation within normal range? What are temporal trends?	water sampling from dedicated monitoring wells in addition to supply wells	bacteria, biological oxygen demand	2.9	
			P27	Marine Water Quality - Microbiology	Is variation within normal range? What are temporal trends?	collection of samples at established sites including controls	bacteria, biological oxygen demand	2.8	
			P28	Surface Water Quality - Microbiology	Is variation within normal range? What are temporal trends?	collection of samples at established sites including controls	bacteria, biological oxygen demand	2.9	
	Monitor toxic and contaminant levels in water		P29	Ground Water Quality - Toxics & contaminants	Is variation within normal range? What are temporal trends?	water sampling from dedicated monitoring wells in addition to supply wells	chemical oxygen demand, heavy metals, herbicides, organics, pesticides	2.8	
			P30	Marine Water Quality - Toxics & contaminants	Is variation within normal range? What are temporal trends?	water sampling, sediment sampling, animal tissue sampling	chemical oxygen demand, heavy metals, herbicides, organics, pesticides	3.0	
			P31	Surface Water Quality - Toxics & contaminants	Is variation within normal range? What are temporal trends?	water sampling, sediment sampling, animal tissue sampling	chemical oxygen demand, heavy metals, herbicides, organics, pesticides	3.7	
	Monitor biological invertebrate communities		P32	Marine Water Quality - macroinvertebrates	What are community dynamics of marine & estuarine sediment communities?	benthic community composition (transects, quadrats, traps, trawls, tows)	diversity, species richness, indicator species, recruitment	2.8	
			P33	Surface Water Quality - macroinvertebrates	What are community dynamics of benthic freshwater communities?	benthic community composition of standard sampling units	diversity, species richness, indicator species, recruitment	2.6	

### Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials ([http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review\\_materials.htm](http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm))

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
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		Cave Systems	Monitor changes in cave communities
		Producers	Monitor community composition, structure, and productivity
	Freshwater Ecosystems	Community	Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
		Population	Monitor extent and response to treatment of established invasive species
			Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Monitor patterns of distribution & extent of community types Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries / collected species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Water column (motile)	Monitor community dynamics, structure, function, and composition Track community and population trends in harvested fisheries species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
			Monitor community dynamics, structure, function, and composition
		Intertidal	Track community and population trends in harvested fisheries collected species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species
			Monitor occurrence of non-established (incipient) invasive species